

## Ve 450 Senior Design

# Camera-Based Real Time Smart Phone Dictionary

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### Executive Summary

Our goal for this major design for engineering course is to create a camera based real-time smart phone dictionary. We analyzed current smart phone dictionary applications and decided its functions, operations and engineering specifications. After that, we developed the image processing, character recognition, word searching algorithm base on some existing methods and technical papers. We wrote testing code in MATLAB and translated into Java and SQL. In the end, we integrated all the parts into smart phone by using Android SDK.

### Introduction

We want to provide a smart phone dictionary application that utilizes the camera as an input method. The dictionary obtains the real time image and then parse the image to get the word. In the end, it looks up the translation results in the internal dictionary database. Moreover, our applications can also connect to some other online professional database such as Wiki, IEEE, ACM etc, in order to serve user who often read technical papers.

### Background

- Over 100,000,000 customers use smart phone, and over 70% of them use the dictionary applications.
- Over 90% smart phone dictionary users are not satisfied with current products.
- Searching words in dictionary using visual QWERT keyboard as input method is extremely tiring and time consuming.

### Criteria

- Accuracy of translation must be larger than 90%.
- Response time should be less than 5 seconds. (Depends on the hardware)
- Operation steps should be less than 5 taps on the screen.

### Final Design

#### Detection Size and Resolution

The detection size and resolution are determined by the smart phone camera specifics. For current general Android

smart phone camera, the detection frame of 5mm by 15mm, which is enough for regular word on papers. On the other hand, for an area of 5\*15 mm area, it can has more than 200\*600 pixels.

### Image Processing and Pattern Recognition

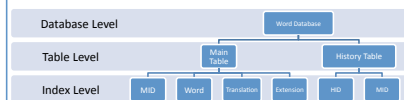
The pattern recognition correctness depends on the image pre-processing and character recognition. We convert image from chromatic format into gray scale and binary images, because we only care about if a pixel belongs to a word or background. Image Segmentation divide image into regions such as lines, words and characters. We compute the projection profile on x-axis and y-axis to detect word position and size.

In our application, We use the features marching for classification. The linear Principal Component Analysis is chosen to generate the decision space unit vectors which can compresses relevant information into the first components of the transformed feature vector.



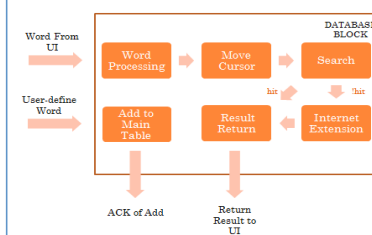
### Tree Searching Levels

To meet the requirements of searching levels, we finally use a database structure as shown below, which is a 3-level linear structure.

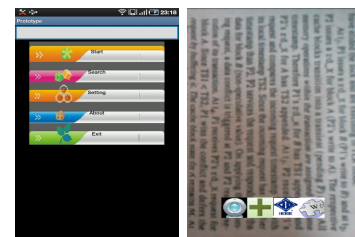


### Operation Steps

For the database search part, the flow chart below clearly shows how we are going to operate.



### Prototype of Final Design



### Evaluation of Prototype

- Accuracy: By testing the words on one screenshot, the accuracy is  $64/81 = 79\%$ ;
- Respond time: The average time from loading image to getting results is about 1.475s on computer. Considering the speed difference, it is around 4.5s on cell phone.
- Operation Steps: Three taps to get the meaning of a word.
- Only lower-case letters can be recognized.

### Recommendations

The accuracy of the image processing algorithm is below the requirements. However, almost all of the errors relates to "f", "i" and "c". We can modify the searching algorithm to adapt blur search to improve the accuracy.

To make the algorithm work on upper-case letters, we need to enlarge the training data.

### Conclusions

- The camera-based real time smart phone dictionary is designed to help users easily translate the materials
- The application can use Internet extensions to find the technical meaning
- The database is open to the users. They can add new word into it and check the search history

### References

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